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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/622,736
Filing Date: October 27, 2000
Appellant(s): ABSAR ET AL.

MAILED

OCT 3 1 2006

Technology Center 2600

Timothy L. Boiler
For Appellant

EXAMINER'S ANSWER

This is in response to the supplemental appeal brief filed on 07/10/2006 appealing from the Office action mailed on 12/17/2004.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5,479,562	Fielder et al.	10-1995
6,304,847	Jhung	10-2001

Proakis et al., "Digital Signal Processing, principles, algorithms, and applications", Textbook, 3ra Edition, 1996, ISBN 0-13-373762-4, pp 290-291, 415 and 475-477.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

1. Claims 1-9 and 17-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fielder et al. (US 5,479,562) hereinafter referenced as Fielder.

As per **claim 1**, Fielder discloses a method and apparatus for encoding and decoding audio information (title), comprising:

"i) multiplying the sequence of digital audio input samples with a first trigonometric function factor to generate an intermediate sample sequence", (col. 35, line 35 to col. 36, line 8 and equation (26), 'premultiply step');

" ii) computing a fast Fourier transform of the intermediate sample sequence to generate a Fourier transform coefficient sequence", (col. 36, lines 9-19 and equation (27));

"iii) for each transform coefficient in the sequence, multiplying the real and imaginary components of the transform coefficient by respective second trigonometric function factors, adding the multiplied real and imaginary transform coefficient components to generate an

addition stream coefficient, and subtracting the multiplied real and imaginary transform coefficient components to generate a subtraction stream coefficients", (col. 36, lines 20-35 and equation (28), 'a postmultiply step').

It is noted that from Fielder's teachings:

$C(k)= R(k)\cos[2\pi(k+1/2)m/N] + Q(k)\sin[2\pi(k+1/2)m/N]$ (28) col. 36, lines 9-35

and $m=(N/2+1)/2$ (6) col. 18, lines 1-6

replace m in the angle term of Eq (28) with Eq (6):

$2\pi(k+1/2)m/N = 2\pi(k+1/2)[(N/2+1)/2]/N = 2\pi(k+1/2)/4 + \pi(k+1/2)/N$ Eq.a

for simplifying expression, let $a =2\pi(k+1/2)/4$, and $b= \pi(k+1/2)/N$ Eq.b

then Eq (28) becomes: $C(k)=R(k)\cos (a+b) + Q(k)\sin(a+b)$ Eq.c

use trigonometric identity: $=R(k) [\cos(a)\cos (b)-(\sin(a)\sin(b)]+Q(k)[\sin(a)\cos(b)+\cos(a)\sin(b)]$ Eq.d

reorganize the terms: $=R(k)\cos(a)\cos(b)-R(k)\sin(a)\sin(b)+Q(k)\sin(a)\cos(b)+Q(k)\cos(a)\sin(b)$ Eq.e

get result: $=\cos(a)[R(k)\cos(b) + Q(k)\sin(b)] - \sin(a)[R(k) \sin (b) - Q(k) \cos(b)]$ Eq.f

which is equivalent to the result of equation 16 in the specification and read on claims 8 or 9 (satisfying the narrowest claims).

"iv) multiplying the addition and subtraction stream coefficients with respective third trigonometric function factors", (col. 36, lines 20-35 and equation (28), 'a postmultiply step', wherein equation (28) has equivalent function and same result as the equation 16 in the specification, as stated in step iii, wherein cos(a) and sin(a) are read on the claimed third trigonometric function factors); and

"v) subtracting the corresponding multiplied addition and subtraction stream coefficients to generate audio coded frequency domain coefficients", (col. 36, lines 20-35 and

equation (28), ‘a postmultiply step’, wherein equation (28) has equivalent function and same result as the equation 16 in the specification, as stated in step iii, wherein the above result is perfect read on the claimed limitation).

It is noted that even though Fielder discloses multiple computation steps, including initial equation, condition, pre-multiply step, and certain result (see equitation 6, 24-28), Fielder does not expressly disclose the intermediate reasoning steps from Eq.d to Eq.f as stated above (for element iii). However, since Fielder has provided eq.28 that comprises trigonometric functions with dividable angle (such as $\cos(2\pi(k+1/2)m/N)$ and $\sin(2\pi(k+1/2)m/N)$), these reasoning steps (Eq.d to Eq.f) is simply using well-known mathematical (trigonometric) identity expressions, which generally requires an artesian in the art having basic trigonometry knowledge. Therefore, it would have been obvious to one of ordinary skill in the art, who had basic trigonometry knowledge, at the time the invention was made to recognize the Fielder' equations and to compute further by using simple mathematical (trigonometric) identity expressions, for the purpose (motivation) of providing a complete computation algorithm by modulating the signals and reducing computational complexity (Fielder: col. 35, lines 60-67).

As per **claim 2** (depending on claim 1), Fielder further discloses “the audio coded frequency domain coefficients comprise modified discrete cosine transform coefficients”, (col. 35, lines 33-59 and equations (24)-(25)).

As per **claim 3** (depending on claim 1), Fielder further discloses that “the first trigonometric function factor for each audio sample is a function of the audio sample sequence position (n) and the number (N) of samples in the sequence”, (col. 36, eq. (26), wherein $\exp(-j\pi n/N) = \cos(-\pi n/N) + j \sin(-\pi n/N)$ and is read on the first trigonometric function factor).

As per **claim 4** (depending on claim 1), Fielder further discloses that "the respective second trigonometric function factors for each transform coefficient in the sequence are respective functions of the transform coefficient sequence position (k) and the number (N) of coefficients in the sequence", (col. 36, eq. (28), see the reasoning equations Eq.a-E.f above in claim 1, element iii, wherein cos(b) and sin(b) are read on the claim, where $b= \pi(k+1/2)/N$).

As per **claim 5** (depending on claim 1), Fielder further discloses that "the respective third trigonometric function factors are respective functions of the transform coefficient sequence position (k)" (col. 36, eq. (28) and col. 18 eq. (6), also see the reasoning equations Eq.a-E.f above in claim 1, element iii, wherein cos(a) and sin(a) are read on the claim, where $a=2\pi(k+1/2)/4$).

As per **claim 6** (depending on claim 1), Fielder does not expressly disclose that "the step i) comprises multiplying the input sequence samples x[n] by the first trigonometric function factor $\cos(\pi n/N)$ to generate the intermediate sample sequence, where: x[n] are the input sequence audio samples; N is the number of input sequence audio samples". However, Fielder discloses multiplying the input sequence samples x[n] by $\cos(-\pi n/N)$ (col. 36, eqs. (26) and (27), where $\exp(-j\,\pi n/N) = \cos(-\pi n/N) + j\sin(-\pi n/N)$), wherein using a negative angle is based on initial assumption for FFT step and pre-multiply step (also see specification: page 9, eq.2 and eq. 10; Fielder: col. 26, equation 26 and 27), which has equivalent functionality as the claimed limitation since there is a conjugation relationship between them (also see specification eq. 12 and eq.13). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize that this is travail difference and the two expressions are

functionally equivalent, and to derive one from the other by using conjugate property, for the purpose of choosing one of two alternative computations for the process.

As per **claim 7** (depending on claim 1), Fielder further discloses that "step ii) comprises computing the fast Fourier transform of the intermediate sample sequence so as to generate said transform coefficient sequence Gk = gk,r + jgk,i, where: Gk is the transform coefficient sequence; gk,r are the real transform coefficient components; gk,i are the imaginary transform coefficient components; and k=0… (N/2 - 1)", (col. 36, eqs. (27) and (28), where X*(k), R(k) and Q(k) correspond to Gk, gk,r and gk,i, respectively).

As per **claim 8** (depending on claim 1), Fielder does not expressly disclose that "step iii) comprises determining the addition stream coefficients T2 and subtraction stream coefficients T1, according to: T1 = gk,r cos (π(k + 1/2)/N) - gk,i sin (π(k + 1/2)/N); T2 =gk,r cos(π(k+1/2)/N) + gk,i sin (π(k+1/2)/N); where T1 and T2 are the subtraction stream and addition stream coefficients, respectively". However, it is noted that there is only a travail difference between the claimed equation and the derived equation Eq.f in the reasoning (see above) for claim 1, element iii. For example, if replace Q'(k) with –Q(k) in Eq.f, the equation becomes C(k) =cos(a)[R(k)cos(b)–Q'(k)sin(b)] – sin(a)[R(k) sin (b)+Q'(k) cos(b)], wherein Q'(k) = -Q(k) = gk,i, which is exactly the same as claimed. The reason for this is that the initial assumption step for FFT and pre-multiply step between the application and the reference have a π (180 degrade) difference in the term exp() (see specification: page 9, eq.2 and eq. 10 and Fielder: col. 26, equation 26 and 27). But, this is travail since there is no any functional or patentable difference at all. Therefore, it would have been obvious to one of ordinary skill in the

art at the time the invention was made to recognize Fielder's equations being functionally equivalent to the computation of the claim.

As per **claim 9** (depending on claim 1), the rejection is based on the same reason described for claim 8, because the rejection for claim 8 covers the same or similar limitations of claim 9, wherein (referring to the reasoning equations Eq.a-E.f above for claim 1, element iii) [R(k)cos(b)–Q'(k)sin(b)] corresponds to T1, [R(k) sin (b)+Q'(k) cos(b)] corresponds to T2, a corresponds to $2\pi(k+1/2)/4 = \pi(2k+1)/4$, as claimed.

As per **claim 17**, the rejection is based on the same reason described for claim 1, because claim 17 recites the same or similar limitation(s) as claim 1.

As per **claim 18** (depending on claim 17), Fielder further discloses that "the pre-multiplication factor, and first and second post-multiplication factors are trigonometric function factors" (col. 36, equations (26) and (28), wherein factor $\exp(-j\ \pi n/N) = \cos(-\ \pi n/N) + j \sin(-\pi n/N)$, and term of $\cos [2\pi\ (k+ ½)\ m/N] = \cos [2\pi\ (k+ ½)/4 + \pi\ (k+ ½)]$ when using equation 16: $m=(N/2 +1)/2$, the result is the same as described for claim 1).

As per **claims 19-21** (depending on claim 17), the rejection is based on the same reason described for claims 3-5 respectively, because claims 19-21 recite the same or similar limitations as claims 3-5 respectively.

As per **claim 22** (depending on claim 17), Fielder further discloses that "the pre-processing operations are performed on each sample in the input sequence individually" (col. 36, equation (27), which shows that the operation is performed on each sample in input x(n) individually).

As per **claim 23** (depending on claim 17), Fielder further discloses that "the post-processing operations are performed on each transform coefficient in the sequence individually", (col. 36, equation (28), which shows that the post-processing operation is performed on each transform coefficient R(k) and Q(k) individually).

2. Claims 10-13, 16 and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fielder in view of Proakis et al. ("Digital Signal Processing, principles, algorithms, and applications", 3rd Edition, 1996, ISBN 0-13-373762-4) hereinafter referenced as Proakis.

As per **claim 10**, Fielder discloses a method and apparatus for encoding and decoding audio information, comprising:

"combining first and second sequences of digital audio samples from first and second audio channels into a single complex sample sequence", (col. 16, line 40 to col. 17, line 11 'a single FFT can be used to perform the DCT and DST simultaneously by defining them respectively as the real and imaginary components of a signal complex (corresponding to a single complex sample sequence) transform' and 'processing a signal sample block from each of the two channels', which suggests that the signal uses the real components for one channel and imaginary components for another channel);

"processing the [complex] sample sequence by multiplying the input sequence samples by a first trigonometric function", (col. 16, line 40 to col. 17, line 11 'a single FFT can be used to perform the DCT and DST simultaneously by defining them respectively as the real and imaginary components of a signal complex (corresponding to a single complex sample sequence)

transform' and 'processing a signal sample block from each of the two channels'; col. 35, line 35 to col. 36, line 8 and equation (26), 'premultiply step')

"determining a Fourier transform coefficient sequence", (col. 16, lines 40-55, 'a single FFT can be used to perform the DCT and DST simultaneously by define them respectively as the real and imaginary components of a signal complex transform', which means that the signal x(n) has real and imaginary components: x(n)=xr(n)+jxi(n); col. 36, lines 9-35 and equations (27)-(28), wherein the equations can also be applied to the complex input signal);

"generating first and second transform coefficient sequences by combining and/or differencing first and second selected transform coefficients from said Fourier transform coefficient sequence", (col. 16, lines 52-55, 'the DCT (first transform coefficient sequences) of one signal samples block can be concurrently calculated with the DST (second transform coefficient sequences) of another signal sample block by only one FFT followed by complex array multiplication and additions (interpreted as combining and/or differencing)').

"for each of the first and second transform coefficient sequences, generating audio coded frequency domain coefficients to generate respective sequences of said audio coded frequency domain coefficients for the first and second audio channels" (col. 16, lines 40-55, 'a single FFT can be used to perform the DCT and DST simultaneously by define them respectively as the real and imaginary components of a signal complex transform'; col. 36, lines 20-55 and equation (28), 'In two-channel systems, signal sample blocks from each of two channels are transformed by FFT processes into DCT1/DCT2 block pair').

Even though, as stated above, Fielder discloses that a single FFT can be used to perform the DCT and DST simultaneously by defining them respectively as the real and imaginary

components of a single complex transform (col. 16, lines 40-55), and further discloses some the intermediate results or steps of processing transform coefficient sequences (equations 6, 24, 26, 27 and 28 and col. 35, line 32 to col. 36, lines 67), Fielder does not expressly teach whether or not the equations (27) and (28) can be applied to a complex input with two signals for FFT calculation. However, this feature is well known in the art as evidenced by Proakis, who teaches symmetry properties of the discrete-time Fourier transform (page 290-291) that discloses the mathematical relationships between different time domain/frequency domain signal components, including even/odd, real/image, and conjugate relations (equations 4.3.37 and 5.2.31, Tables 4.4 and 5.1, and Fig. 4.29), specially combining the third and fourth properties in Tables 4.4 and 5.1, which corresponds the claimed limitation. Particularly, Proakis teaches an efficient computation of the DFT of two real sequences (page 475-476) that can compute two real signal sequences in a complex-valued sequence by performing a single DFT (FFT), so that the respective sequences of audio frequency domain coefficient sequences for the two real signal sequences (corresponding to two audio channel signals) can be derived by using the FFT transformed coefficients and the symmetry properties. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Fielder by specifically providing a FFT algorithm to perform a single DFT for two real signal (two channel) sequences by using the symmetry properties of the Fourier transform, as taught by Proakis, for the purpose of enhancing the efficiency of the FFT algorithm (Proakis: page 475, paragraph 6).

It is noted that the rejection by using mathematical reasoning for claim 1 can also be applied to the rejection for claim 10, wherein the difference is that claim 1 has only one input signal (as real part) while claim 10 has two input signals as a complex input ($x(n)=xr(n)+jxi(n)$).

As per **claim 11** (depending on claim 10), Fielder in view of Proakis further discloses that "for each corresponding coefficient in the first and second transform coefficient sequences, selecting first and second transform coefficients from said Fourier transform coefficient sequence, determining a complex conjugate of said second transform coefficient, combining said first transform coefficient and said complex conjugate for said first transform coefficient sequence and differencing said first transform coefficient and said complex conjugate for said second transform coefficient sequence", (Fielder: col. 36, lines 35 and equations (27)-(28) and (6); Proakis: pages 290-291, equation 4.3.37 and Table 4.4, wherein two time domain signal sequences can be defined as a complex sequence: x(n) = xr(n) + jxi(n); the frequency domain sequence can be expressed by: X(k)=FFT[xr(n)exp(-jnπ/N)+jxi(n)exp(-jnπ/N)] = Xr(k)+jXi(k), which corresponds to equation (27) of Fielder; and the frequency domain sequence can be further expressed by: X(k)= Xr(k)+jXi(k) = [Xre(k)+jXio(k)] + [Xro(k)+jXie(k)], wherein the subscripts indicate: r -- real part, i –imaginary part, e – even part, o – odd part, which corresponds to terms R(k) and Q(k) in equation (28) of Fielder by combining symmetry properties on equation 4.4.37 (Proakis: page 290) and complex conjugate process in Table 5.1 (Proakis: page 415), wherein equation (28) of Fielder has the same form, but the R(k) and Q(k) include both components from the first and second signals xr and xi, and using third and fourth properties in Table 4.4 or 5.1, then two audio signal frequency sequences can be obtained).

As per **claim 12** (depending on claim 10), the rejection is based on the same reason described for claims 6 and 10, because the rejection for claims 1 and 10 covers the same or similar limitations as claim 12.

As per **claim 13** (depending on claim 11), Fielder in view of Proakis further discloses a properties of DFT: Xe(k)=1/2[X(k)+X*(N-k)] and Xo(k)=1/2[X(k)-X*(N-k)] (Proakis: page 415, Table 5.1) and the derived equations for computation of the DFT of two real sequences (Proakis: page 476, equations 6.2.7 and 6.2.8), where e indicates even part, o indicates odd part, and X(k) corresponds to coefficient X*(k) in equation (27) of Fielder (Fielder: col. 36, lines 1-35), so that the combined teachings correspond to the clamed "said first and second transform coefficient sequences are generated according to: Gk (Zk + Z*N-k-1)/2, G'k (Zk - Z*N-k-1)/2j where Gk is said first transform coefficient sequence; G'k is said second transform coefficient sequence; N is the number of input sequence audio samples; k = 0,..., (N/2 - 1); Zk is said first transform coefficient; Z*N-k-1 is the complex conjugate of said second transform coefficient; and j is the complex constant".

As per **claim 16** (depending on claim 10), Fielder in view of Proakis further discloses "applying a windowing function in combination with multiplying the complex sample sequence by a first trigonometric function factor", (Fielder: Fig. 1a, 'analysis widow 103'; Figs. 6a-6d).

As per **claim 24**, it recites audio coding method, which corresponds to the combination of claims 1, 10 and 13. The rejection is based on the same reason described for claims 1,10 and 13, because claim 24 recites the same or similar limitation(s) as claims 1,10 and 13.

As per **claims 25** (depending on claim 24), the rejection is based on the same reason described for claim 3, because claim 25 recites the same or similar limitation(s) as claim 3.

As per **claims 26** (depending on claim 24), the rejection is based on the same reason described for claim 18, because claim 26 recites the same or similar limitation(s) as claim 18.

As per **claim 27**, Fielder discloses a method and apparatus for encoding and decoding audio information, comprising:

"obtaining first and second input sequences of digital audio samples x[n], y[n] corresponding to respective first and second audio channels", (col. 16, line 40 to col. 17, line 11, 'both input signal sample blocks consist only real-valued samples' and 'processing a signal sample block from each of the two channels');

"combining the first and second input sequences of digital audio samples into a single complex input sample sequence z[n], where z[n] = x[n] + jy[n]", (col. 16, lines 43-64; 'a single FFT can be used to perform the DCT and DST simultaneously by define them respectively as the real and imaginary components of a signal complex transform', which means that the signal x(n) has real and imaginary components: x(n)=xr(n)+jxi(n));

"pre-processing the complex input sequence samples including applying a pre-multiplication factor cos(π n/N) +jsin(π n/N) to obtain modified complex input sequence samples, where N is the number of audio samples in each of the first and second input sequences and n = 0,..., (N-1)", (col. 36, equations (26) and (27), wherein a factor exp(-j πn/N) = cos(-πn/N) + j sin (- πn/N) is used for pre-multiplying and a negative angle is chosen based on initial assumption for FFT step and pre-multiply step (also see specification: page 9, eq.2 and eq. 10; Fielder: col. 26, equation 26 and 27), which has equivalent functionality as claimed, so that it is obvious to one skilled in the art to recognize that this is travail difference and two expressions are functionally equivalent, and one of two can be derived from the other by using conjugate relationship);

"transforming the modified complex input sequence samples into a complex transform coefficient sequence Zk utilizing a fast Fourier transform, wherein k = 0,..., (N/2- 1)", (col. 16, lines 40-55, 'a single FFT can be used to perform the DCT and DST simultaneously by define them respectively as the real and imaginary components of a signal complex transform'; equations 27 and col. 17, lines 3-9, 'processing a signal sample block from each of the two channels ...', which means the input x(n) includes two sequences combined in a complex sequence, so that it is obvious to one skilled in the art to recognize that equation (27) can be expressed as: $X^*(k)= FFT[xr(n)\exp(-jn\pi/N) + jxi(n)\exp(-jn\pi/N)]$); and

"post-processing the sequence of complex transform coefficients to obtain first and second sequences of audio coded frequency domain coefficients" (col. 36, lines 9-35 and equations (28), 'postmultiply step', with same reason described for claim 1, step iv).

But, Fielder does not expressly disclose the coefficients "corresponding to the first and second audio channels Xk, Yk" according to the claimed equations for the two-channels. However, the feature of using one DFT for two input channel signals and obtaining the respective coefficients by applying DFT properties is well known in the art as evidenced by Proakis, who teaches symmetry properties of the discrete-time Fourier transform (page 290-291) that disclose mathematical relationships between different time domain/frequency domain signal components, and efficient computation of the DFT of two real sequences (page 475-476) that combines the two real signal (two channel) sequences into a complex-valued sequence for performing a single DFT (or FFT), so that the respective sequences of audio frequency domain coefficient sequences for the two real signal sequences (corresponding to two audio channel signals) can be derived by using the FFT transformed coefficients and the symmetry properties.

Particularly, Proakis discloses equations 6.2.7 and 6.2.8 (page 476) that are equivalent to the claimed Gk and G'k, and symmetry equation 5.2.31 (page 415), which can be used in Eq. 28 of Fielder to generate the claimed result by following mathematically reasoning:

from Fielder teachings:

input signal is $x(n)=xr(n)+jxi(n)$ col. 16, lines 40-55 and col. 17, lines 2-11

where x(n) is expressed as a complex signal, xr(n) is one real signal (first channels signal) as real part, xi(n) is another real signal (second channels signal) as imaginary part.

corresponding FFT: $X^*(k) = FFT[x(n)\exp(-jn\pi/N)]$ (27) col. 36, lines 9-35

$$= FFT[xr(n)\exp(-jn\pi/N) + jxi(n)\exp(-jn\pi/N)]$$

from Fielder: $m=(N/2+1)/2$ (6) col. 18, lines 1-6 and

$C(k)= R(k)\cos[2\pi(k+1/2)m/N] + Q(k)\sin[2\pi(k+1/2)m/N]$ (28)col. 36, lines 9-35

replace m in the angle term of Eq 28 with Eq 6:

the angle becomes: $2\pi(k+1/2)m/N = 2\pi(k+1/2)[(N/2+1)/2]/N = 2\pi(k+1/2)/4 + \pi(k+1/2)/N$

for simplifying expression: let $a=2\pi(k+1/2)/4$, $b=\pi(k+1/2)/N$

the Eq 28 becomes: $C(k)= R(k)\cos(a+b) + Q(k)\sin(a+b)$

further reasoning by using use trigonometric identity expressions:

$C(k) =R(k) [\cos(a)\cos (b)-(\sin(a)\sin(b)] + Q(k)[\sin(a)\cos(b)+\cos(a)\sin(b)]$ Eq.d.

reorganize the terms: $= R(k)\cos(a)\cos(b)-R(k)\sin(a)\sin(b) + Q(k)\sin(a)\cos(b)+Q(k)\cos(a)\sin(b)$ Eq.e

$=\cos(a)[R(k)\cos(b) + Q(k)\sin(b)]-\sin(a)[R(k) \sin (b) - Q(k) \cos(b)]$ Eq.f

for simplifying expression: let $Xr=R(k)= Xre+Xro$, $Xi=-Q(k)=Xie+Xio$,

$X(k)=(X^*(k))^* = Xr+jXi=(Xre+Xro)+j(Xie+Xio)$ Eq.h

where, subscripts indicate: r—real part, i—imaginary part, e—even part, o—odd part

then eq 28 becomes:

$C(k) = R(k)\cos(a+b) + Q(k)\sin(a+b) = Xr\cos(a+b) - Xi\sin(a+b)$ Eq.i

$= Xr[\cos(a)\cos(b) - (\sin(a)\sin(b)] - Xi[\sin(a)\cos(b)+\cos(a)\sin(b)]$ Eq.j

$=\cos(a)[(Xre+Xro)\cos(b)-(Xie+Xio)\sin(b)]-\sin(a)[(Xre+Xro)\sin(b)+(Xie+Xio)\cos(b)]$ Eq.k

from Proakis' teachings(page 415, Table 5.1 and equation 5.2.31; page 476, equations 6.2.7 and 6.2.8): even part of frequency coefficients corresponds to real part of input sequence x1(n):

$X1(k) = [X(k)+(X^*(N-k)]/2=Xre+jXie$ Eq.l

and odd part of frequency coefficients corresponds to imaginary part of input sequence x2(n)

$X2(k)=[X(k)+(X^*(N-k)]/j2=Xro+jXio$ Eq.m

thus, the terms Xre, Xie, Xro and Xio are known from Eq.1 and Eq.m, and then after reorganizing Eq.k, the separated even and odd parts of frequency coefficients are respectively obtained:

$C(k) = \{\cos(a)[Xre\cos(b)-Xie\sin(b)]-\sin(a)[Xre\sin(b)+Xie\cos(b)]\}$ Eq.n

$\{\cos(a)[Xro\cos(b)-Xio\sin(b)]-\sin(a)[Xro\sin(b)+Xio\cos(b)]\}$

where the terms Xre, Xie, Xro and Xio are respectively read on the claimed terms gk,r, gk,i, g'k,r and g'k,i (in the narrowest claim 27), which covers all limitations as claimed.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize that the above reasoning can be derived from Fielder' equations by using simple mathematical identity expressions (basic trigonometry knowledge) and/or Proakis' teachings of the symmetry properties of FFT transform coefficients, and to modify Fielder by providing a FFT algorithm by performing a single DFT (or FFT) for two real signal (two channel) sequences by using the symmetry properties of Fourier transform, as taught by

Proakis, for the purpose (motivation) of enhancing the efficiency of the FFT algorithm (Proakis: page 475, paragraph 6).

3. Claims 14-15 and 28-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fielder in view of Proakis and further in view of Jhung (US 6304847 B1).

As per **claim 14** (depending on claim 10), even though Fielder teaches the tradeoff of using longer or shorter block length for a transform (col. 3, lines 30-67), Fielder in view of Proakis does not expressly disclose "examining said first and second sequences of digital audio samples to determine a short or long transform length, and coding the audio samples using a short or long transform length as determined". However, this feature is well known in the art as evidenced by Jhung, who discloses that the Dolly AC-3 standard utilizes long transform or two short transform based on the transition condition (col. 3, line 62 to col. 4, line 24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Fielder in view of Proakis by providing long transform or two short transform based on the transition condition, as taught by Jhung, for the purpose (motivation) of handling different transition situations (Proakis: col. 3, line 63 to col. 4, line 2).

As per **claim 15** (depending on claim 10), Fielder teaches the tradeoff of using longer or shorter block length for a transform (col. 3, lines 30-67) and "pairing the channels according to their determined transform length, and coding the audio samples of first and second channels in each pair according to determined transform length", (col. 17, lines 3-25, 'two-channel system', processing a signal sample block (necessarily including a determined transform length) from each of the two channels: a DCT block...and A DST block', 'the coded (coding) block for given

channel alternate (pairing) between the DCT and DST', 'a pair of blocks, one for each channel, are quantized and formatted (coding)'). But, Fielder in view of Proakis does not expressly disclose "determining a transform length for each of the channels". However, this feature is well known in the art as evidenced by Jhung, who discloses that the Dolly AC-3 standard utilizes long transform or two short transform based on the transition condition (determining transform length) (col. 3, line 62 to col. 4, line 24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Fielder in view of Proakis by providing a long transform or two short transform based on the transition condition (determining transform length) as taught by Jhung, for the purpose (motivation) of handling different transition situations (Proakis: col. 3, line 63 to col. 4, line 2).

4. As per **claims 28-39**, they recite an apparatus for coding input audio samples. The rejection is based on the same reason described for claims 1-2, 18, 3-5, 22-23, 14, 10 and 38-39 respectively, because claims 28-39 recite the same or similar limitation(s) as claims 1-2, 18, 3-5, 22-23, 14, 10 and 38-39 respectively.

(10) Response to Argument

Rejection under 35 USC 103(a)

Appellant's arguments filed 07/10/2006, regarding the rejection under 35 USC 103(a) (see supplemental brief hereinafter referenced Brief, pages 14-25) have been fully considered but they are not persuasive.

(a). In response to appellant's arguments (Brief : page 10, paragraph 4 to page 15, paragraph 2) regarding claims 1-9 and 17-23 that “the examiner point to no portion of Fielder suggesting that the claimed intermediate steps should be derived” (Brief : page 17, paragraph 2), “claims 1-9 are not rendered obvious by Fielder” and “the examiner has failed to establish a prima facie case of obviousness” (Brief : page 18, paragraphs 1-2), the examiner respectfully disagrees with appellant and has a different view of the prior art teachings and the claim interpretations. It is noted that the specification is based on a series of mathematic reasoning (Eq1.-Eq.16) while the independent claim 1(also claim 17) is based on a series of textural statements, which may have a broader scope than that of specification, so that the examiner's rejection follows the same manner and covers all the limitations as claimed (see detail in the rejection).

In order to better explain the examiner's position and discuss the argued issues, the examiner provide a complete continued mathematical reasoning steps as following:

(b) For one input signal

From Fielder's teachings:

$X^{*}(k)=FFT[x(n)\exp(-j\pi n/N)$ (26) col. 36, lines 9-35

$C(k)= R(k)\cos[2\pi(k+1/2)m/N] + Q(k)\sin[2\pi(k+1/2)m/N]$ (28) col. 36, lines 9-35

$m=(N/2+1)/2$ (6) col. 18, lines 1-6

replace m in the angle term of Eq 28 with Eq 6:

the angle term is: $2\pi(k+1/2)m/N= 2\pi(k+1/2)[(N/2+1)/2]/N = 2\pi(k+1/2)/4 + \pi(k+1/2)/N$ Eq.a

for simplifying expression, let $a =2\pi(k+1/2)/4$, and $b= \pi(k+1/2)/N$ Eq.b

then Eq. 28 becomes: $C(k)= R(k)\cos(a+b) + Q(k)\sin(a+b)$ Eq.c

further reasoning for Eq 28 by use trigonometric identity expressions

$$C(k) = R(k)[\cos(a)\cos(b)-(\sin(a)\sin(b)] + Q(k)[\sin(a)\cos(b)+\cos(a)\sin(b)] \quad \text{Eq.d}$$

reorganize the terms: $= R(k)\cos(a)\cos(b)-R(k)\sin(a)\sin(b)+(k)\sin(a)\cos(b)+Q(k)\cos(a)\sin(b)$ Eq.e

$=\cos(a)[R(k)\cos(b) + Q(k)\sin(b)] - \sin(a)[R(k) \sin (b)- (k) \cos(b)]$ Eq.f

or let $Q'(k)=Q(k)$: $=\cos(a)[R(k)\cos(b)-Q'(k)\sin(b)] - \sin(a)[R(k) \sin (b)+Q'(k) \cos(b)]$ Eq.g

this result is equivalent to claims 8 and/or 9 (narrowest claims) (and equation 16 of the specification), wherein $[R(k)\cos(b)+Q(k)\sin(b)]$, $[R(k)\sin (b)-Q(k)\cos(b)]$, $R(k)$, $Q'(k)$ correspond to T1, T2, gk,r and gk,i respectively, and angle $a=2\pi(k+1/2)/4$, angle $b=\pi(k+1/2)/N$, as claimed.

It is noted that the reason gk,i= $Q'(k) = -Q(k)$ is that the initial assumption for FFT and pre-multiply step between the application and the reference has a π (180 degrade) difference in the term exp() (see specification: page 9, eq.2 and eq. 10; Fielder: col. 26, equations (26)-(27)). But, this is travail since it is obvious to one skilled in the art to recognize that this small difference is because of arbitrarily choosing one of two initial assumptions and/or there is no effect in changing functionality or patentability of the claim.

It is can be seen that the claims 1-5 and 17-23 are nothing more than textual version limitations of the mathematical version (equation) limitations of claims 6-9, wherein the claims 8-9 are most comprehensive (narrowest) claims. As stated in the claim rejection, Fielder discloses multiple computation steps, including the same or equivalent initial, conditional, certain intermediate and resultant equations (Fielder: equation (1), (6), (24)-(28)). What Fielder does not expressly disclose is the reasoning from Eq.c to Eq.f (or Eq.g) expressed above. It is noted that the propose of reasoning these equations is only to show the obviousness of how ordinary person skilled in the art can easily derive from Fielder's discloses/equations to the claimed steps/terms. In fact, the claims do not recite all these equations or the corresponding reasoning. According to the appellant's arguments that the examiner

shows the Fielder **could** have preformed the claimed steps not **actually** disclosed or suggested (Brief: page 18, paragraph 1 to page 20 paragraph 4), it appears that appellant recognizes that the examiner's reasoning is correct but does not think of the reasoning steps being obvious. It is noted that, as stated in the rejection and described in this section above, the examiner shows all claimed steps/equations/terms by simple mathematical reasoning based on Fielder's equations (equation (1), (6), (24)-(28)) and basic trigonometry identity expressions that is well known in that art, so that it is obvious to one skilled in the art to recognize that these mathematical identity expressions being functionally equivalent, which provides proper basis of obviousness for the mathematical reasoning stated above. Further, it should be pointed out that, the above complete mathematical reasoning can be applied to the narrowest claims (such as claims 8 and 9) in the group of claims 1-9 and 17-23, which covers all limitations as claimed, including the argued limitations iii), iv) and v) of claim 1 and the argued terms for claim 6, 8-9 and 17-23 (Brief: page 18, paragraph 1 to page 20 paragraph 4). In addition, the rejection for claim 1 does not have to use all above steps (such as Fielder's equation (6) for replacing), since the limitations of claim 1 is only in textural version that has a broader scope and that other type of equation(s) may be read on.

Furthermore, the argument (for claims 1-9 and 17-23) regarding the secondary reference (Proakis) (Brief: page 17, last ten lines) is irrelevant, because the rejection of claims 1-9 and 17-23 is nothing to do with the secondary reference (see rejection above).

(c). In response to appellant's arguments (Brief: page 21, paragraph 1 to page 24, paragraph 1) regarding claims 10-13, 16 and 24-27 that "Fielder is not an appropriate primary reference and further that modifying Fielder as suggest by the examiner would be improperly change the function and principles of operation of Fielder"(Brief: page 21, paragraph 2), "the examiner …do not disclose or suggest the claimed intermediate steps" (Brief: page 22, paragraph 1), and "the

examiner has failed to make a prima facie showing of obviousness" with regard to the claims (Brief : page 23, paragraph 1 and page 24, paragraph 1), the examiner respectfully disagrees with appellant and has a different view of the prior art teachings and the claim interpretations.

It is noted that the major deference between this claim group and the previous discussed claim group is that this claim group includes two input signals (or two channel signals) with one DFT (or FFT) computation. Similar to response for the previous claim group, in order to better explain the examiner's position and discuss the argued issues, rather than scattering pieces of rejections in the separate claims (as stated in each claim rejection), the examiner provide a complete continued mathematical reasoning steps as following:

(d). For two input signals

From Fielder teachings:

input signal is $x(n)=xr(n)+jxi(n)$ col. 16, lines 40-55 and col. 17, lines 2-11

where $x(n)$ is expressed as a complex signal, $xr(n)$ is one real signal (first channel signal) as real part, $xi(n)$ is another real signal (second channel signal) as imaginary part.

The corresponding FFT is: $X^*(k) = FFT[x(n)\exp(-jn\pi/N)]$ (27) col. 36, lines 9-35

$= FFT[xr(n)\exp(-jn\pi/N) + jxi(n)\exp(-jn\pi/N)]$

from Fielder: $m=(N/2+1)/2$ (6) col. 18, lines 1-6 and

$C(k)= R(k)\cos[2\pi(k+1/2)m/N]+Q(k)\sin[2\pi(k+1/2)m/N]$ (28)col. 36, lines 9-35

replace m in the angle term of Eq 28 with Eq 6:

the angle becomes: $2\pi(k+1/2)m/N = 2\pi(k+1/2)[(N/2+1)/2]/N = 2\pi(k+1/2)/4 + \pi(k+1/2)/N$

for simplifying expression: let $a=2\pi(k+1/2)/4$, $b=\pi(k+1/2)/N$

the Eq 28 becomes: $C(k)= R(k)\cos(a+b) + Q(k)\sin(a+b)$

Examiner further reasoning (similar to single signal input) by using trigonometric identity expression:

$$C(k) = R(k)\,[\cos(a)\cos(b)-(\sin(a)\sin(b)] + Q(k)[\sin(a)\cos(b)+\cos(a)\sin(b)] \qquad \text{Eq.d.}$$

reorganize the terms: $= R(k)\cos(a)\cos(b)-R(k)\sin(a)\sin(b) + Q(k)\sin(a)\cos(b)+Q(k)\cos(a)\sin(b)$ Eq.e

$$=\cos(a)[\,R(k)\cos(b) + Q(k)\sin(b)]-\sin(a)[\,R(k)\sin(b) - Q(k)\cos(b)] \qquad \text{Eq.f}$$

or let $Q'(k)=Q(k)$ $=\cos(a)[\,R(k)\cos(b)-Q'(k)\sin(b)]-\sin(a)[\,R(k)\sin(b)+Q'(k)\cos(b)]$ Eq.g

for simplifying expression: let $Xr=R(k)= Xre+Xro$, $Xi= -Q(k)= Xie+Xio$,

$$X(k)=(X^*(k))^*=[R(k)-jQ(k)]= Xr+jXi=(Xre+Xro)+j(Xie+Xio), \qquad \text{Eq.h}$$

where, subscripts indicate: r—real part, i—imaginary part, e—even part, o—odd part

then eq 28 becomes:

$$C(k) = Xr\cos(a+b) - Xi\sin(a+b) \qquad \text{Eq.i}$$

$$= Xr\,[\cos(a)\cos(b) - (\sin(a)\sin(b)] - Xi[\sin(a)\cos(b)+\cos(a)\sin(b)] \qquad \text{Eq.j}$$

$$=\cos(a)[(Xre+Xro)\cos(b)-(Xie+Xio)\sin(b)]-\sin(a)[(Xre+Xro)\sin(b)+(Xie+Xio)\cos(b)] \qquad \text{Eq.k}$$

Since Proakis teaches that:

even part of frequency coefficients corresponds to real part of input sequence x1(n):

$$X1(k) = [X(k)+(X^*(N-k)]/2=Xre+jXie \qquad \text{Eq.l}$$

and odd part of frequency coefficients corresponds to imaginary part of input sequence x2(n)

$$X2(k)=[X(k)+(X^*(N-k)]/j2=Xro+jXio \qquad \text{Eq.m}$$

(see Proakis: page 415, Table 5.1 and equation 5.2.31; page 476, equations 6.2.7 and 6.2.8), thus, the terms Xre, Xie, Xro and Xio are known from Eq.1 and Eq.m, and then after reorganizing Eq.k, the separated even and odd parts of frequency coefficients are respectively obtained,

$$C(k) = \{\cos(a)[Xre\cos(b)-Xie\sin(b)]-\sin(a)[Xre\sin(b)+Xie\cos(b)]\} \qquad \text{Eq.n}$$

$$\{\cos(a)[Xro\cos(b)-Xio\sin(b)]-\sin(a)[Xro\sin(b)+Xio\cos(b)]\}$$

this result is equivalent to the claim 27 and corresponds to the two input signal sequences respectively, wherein the terms Xre, Xie, Xro and Xio are respectively read on the claimed terms gk,r, gk,i, g'k,r and g'k,i in the narrowest claim 27.

As stated above, Fielder teaches using one FFT transform for two input signals (two channel signals) and discloses multiple computation steps, including initial equation, condition, pre-multiply step, and certain result (see equitation 6, 24-28). It is noted that the steps for eq.d to eq.k are the same as described for single input (see above), because these equations use the same or similar mathematical (trigonometric) identity expressions for the reasoning. It can be seen that examiner introduces the second reference (Proakis) for eq.l to eq.n, which provides commonly used DFT (or FFT) proprieties in the art, such as time-frequency domain symmetric proprieties for mapping real, imaginary, even and odd components. However, this type of mathematical reasoning is fairly simple, therefore, it would be obvious to one skilled in the art to combine the teachings of Fielder and Proakis to result the identical or equivalent conclusion, for the purpose (motivation) of enhancing the efficiency of the FFT algorithm (Proakis: page 475, paragraph 6).

In respond to appellant's argument that "Fielder does not teach or suggest using a Fourier transform coefficient sequence to generate first and second transform coefficient sequences as the examiner suggests" (Brief : page 22, paragraph 2), it is noted that Fielder teaches that 'a single FFT can be used to perform the DCT and DST simultaneously by define them respectively as the real and imaginary components of a signal complex transform' and 'the DCT of one signal samples block can be concurrently calculated with the DST of another signal sample block by only one FFT followed by complex array multiplication and additions' (col. 16, lines 40-55), which clearly teaches or suggests the argued issue(s) and claimed limitation(s).

In response to appellant's argument that there is no suggestion to combine the references (Brief : page 21, paragraph 1, page 23 paragraph 1 and page 18, paragraph 1), the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the obviousness is based on the prior art teachings and/or well-known common knowledge in the art. It is noted that, as stated in the claim rejection, the both references teach using one DFT (or FFT) for two input signals, which intend to solve the same problem with the same idea. Particularly, the second reference is a textbook for undergraduate student in signal processing art, and teaches how to use the common properties of Fourier transform (page 415) and efficient computation of DFT of two real sequences (page 475, last paragraph), which provides the strong evidence of the argued obviousness issue and the motivation for combining the two references (also see detail in the claim rejection). Further, the above mathematical reasoning (such as Eq.c to Eq.f or Eq.h to Eq.k) is based on basic trigonometry identity expressions and conjugate relationship properties, which is so well known that a person skilled in signal processing art would easily recognize and use these mathematical reasoning and properties to obtain an identical or equivalent result.

(e). In response to appellant's arguments (Brief : page 24, paragraph 2 to page 25, paragraph 1) regarding claims 14-15 and 28-39, that "the examiner does not contend that Jhung teaches or suggests the claimed intermediate steps missing from Fielder and Proakis", it is noted that the

appellant argues the same or similar issues in the previous claim groups, therefore, the response to these argued issues is directed to the response for the previous claim groups (see above). It is also noted that there is no specific issue regarding the reference of Jhung, so that the response is generally directed to the related claim rejection (see above).

(f). For the above reason, the examiner believes that the rejection based on Fielder as primary reference and the rejection based on the combined references of Fielder, Proakis and Jhung are proper. The rejections should be sustained.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

Respectfully submitted,

QI HAN

October 25, 2006

Conferees
(August 4, 2005)

Richemond Dorvil David Knepper Hoa Nguyen Qi Han

10/27/06

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